LUBRICATION

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EDITORIALS

Never before has there been such a demand upon every person in this country for personal sacrifice in order to give aid to our Government in the prosecution of the enormous task that it has set itself. Every organization as well has had to make great sacrifice in furnishing men for the various Government activities, and for the actual fighting forces. The Texas Company is proud of its record in already having furnished 1,130 men for the service; and there are thousands of companies throughout the country which have furnished as large a proportion of their employees.

Daily we are met with new requests from the Food Administration for the conservation of food in our homes. Such requests have been met cheerfully and large amounts of food stuffs have been conserved for use in feeding our soldiers and those of our Allies. In addition, we are all so managing our expenditures that we may be able to contribute to the expenses of our Government by the purchase of Liberty Bonds and War Saving Certificates.

There is another means of conservation with which every member of our organization is familiar, which is being urged daily by our men, but the urgency of which the general public does not fully appreciate. This is the immediate, pressing, and paramount need for the saving of lubricating oil.

We believe that we are conservative in saying that in normal times fifty per cent. of the lubricating oil purchased is wasted. With the rapid expansion of manufacturing plants and the great urgency for largely increased production wastes of lubricating oil are undoubtedly even greater than in normal times.

Without supplies of lubricants the war would stop today. The plants that manufacture munitions and materials of all kinds for our army, the ships that convey our troops and supplies across the ocean, the railroads that carry men and materials to the fighting lines, the trucks engaged in service on the front, the aeroplanes that patrol and guard the lines, and all of the artillery, from the large guns at the rear to the machine guns in the trenches—all would come to a

standstill today if it were not for the supply of lubricants.

In peace times, now long past, there was a supply of lubricants fully ample for all needs, but, with the ever increasing demand since the war began, even with the additional manufacturing facilities built, there has been such an increased consumption that manufacturing facilities for lubricating products are today taxed to the utmost. While new lubricating plants are being built and we may expect increased amounts of such products, the great fleets of ships that are being built, the enormous increase in the use of motor trucks, and the use of great aeroplane fleets as soon as they can be built—all of these will require enormous additional quantities of lubricants.

It is imperative, therefore, that every user of lubricants eliminate every bit of waste. If this is done there is not the slightest question but that there will be ample supplies for every need.

When oil is received in wood barrels, this oil should be stored in a suitable place and every precaution taken to keep the barrels from leaking; and it is preferable wherever possible to empty the contents when received into suitable metal containers, being sure to completely drain the barrels. Allowance systems should be put into effect and no more oil issued than is absolutely necessary for the lubrication of each piece of mechanical equipment. All oil should be caught, filtered, and used over again wherever possible. Drip pans should be placed under all machines where oil drips from bearings, and this oil should be reclaimed for re-use. The oil in all oily waste should be extracted in a suitable press or centrifuge and re-used. Circulating systems should be inspected regularly to see that there are no leaks in tanks or lines, and overflows to sewers should be inspected regularly to see that no oil is being carried over. Cylinder oils should be drained from receivers, and separators installed on all exhaust lines to reclaim the oil for future use. All hand oilers should be of suitable design, so that oil may not be used extravagantly, and oilers should be instructed as to the proper amounts of oil to be used. In automobile plants, where large quantities of oil are used for block testing, and even in commercial plants and garages where large amounts of oil are frequently drawn off from the crank case, proper means of reclaiming this oil for some other use should be installed. In machine shops using large quantities of cutting oils, oils should wherever possible be supplied from a central system, and the oil should be reclaimed and sterilized for re-use.

There are a large number of very efficient reclaimers, filters, oil-saving devices, and suitable lubricators on the market, and it is every manufacturer's duty to see that his plant is equipped with all of these devices to help him reduce the amount of new oil used.

In many plants the employment of one or more men whose duty it shall be to supervise the use of oil, even in normal times, will more than pay for the expense entailed and, at the present time, irrespective of expense, it should be considered by manufacturers.

We cannot emphasize too strongly the urgency of saving lubricants at the present time, and the engineering force of The Texas Company is at the service of all for any suggestions or help that their practical experience in the use and conservation of lubricants enables them to give.

The article on Lubrication of Refrigeration Machinery by The Lubrication Engineers Association of The Texas Company, published in this issue, is especially timely. In the first place, this is the season of the year which marks the beginning of the period of greatest activity of the ice manufacturing plants; and in the second place, this is a time when every possible means of conservation should be adopted. The proper lubrication of ice machines will not only accomplish conservation of oil, but by maintaining a seal between the piston and the walls of the compressor cylinder, thus giving maximum compression, the unit will work at maximum efficiency. At the present moment also a serious shortage of ammonia is threatened because of the increased use of ammonia for war purposes, and, as explained in the article, no step could be taken to reduce the amount of ammonia consumed to a minimum which would be more effective than the use of a lubricant which will not foul the coils.

In the manufacture of ice, oil separators play a part of great importance not only because a proper separation is necessary in order to produce clear ice but also because a properly separated oil may, in many cases, be used again. While the article in this issue on Oil Separators for the Exhaust Steam is devoted largely to the discussion of one particular device, it is the intention of the article to emphasize the need of the use of proper mechanical devices, of which there are a large number on the market, for this purpose. Co-operation between manufacturers of ice machines, manufacturers of lubricating devices, and the lubrication engineer is bound to result in the most efficient devices not only for separating oil but for other purposes as well.

LUBRICATION OF REFRIGERATION MACHINERY

By The
Lubrication Engineers Association of The Texas Company

THE lubrication of refrigeration machinery differs somewhat from the lubrication of other machinery in that especial attention must be paid to the action of the lubricant in parts of the refrigerating system other than those requiring lubrication. The action of the lubricant and the method by which it is handled in such places determine to a large extent the choice of the oil itself. In order to know what characteristics are necessary in an oil to meet the conditions, a thoro understanding of the principles of the various methods of refrigeration is required.

Refrigeration may be defined briefly as the process of lowering temperature by the removal of heat, which may be accomplished either by direct chemical action or by mechanical means. Refrigeration produced thru the mixture of chemicals that absorb heat, is quite expensive and on this account is little used for commercial purposes.

Mechanical refrigerating systems all depend upon the principles of compression and expansion and the interchange of heat. In all of the various types coming under this general heading some sort of refrigerating medium is employed

which has a low boiling point at ordinary pressures, large latent heat of vaporization and small specific volume. The agents frequently used are:

Water
Air
Ammonia
Carbon Dioxide
Sulphur Dioxide
Ethyl Chloride

Of these agents, ammonia, carbon dioxide, sulphur dioxide and air are most widely used for commercial purposes.

The various methods employed may be divided into two general classes, viz., machines employing liquefying gases and those employing air as the refrigerating medium. The system using liquefying gases may be subdivided into two classes, namely, absorption and vacuum machines, and compression machines. Air refrigeration systems may be of the closed cycle type, in which the air is continually used, or the open cycle type, in which the air is circulated thru the rooms to be cooled. Without discussing the superiority of any of these systems or their suitability for any class of work, this article will endeavor to explain the practical lubricating requirements of such refrigerating systems as they are now operated.

Absorption System—Taking for the purpose of illustration a system employing ammonia as the refrigerating medium, the process is briefly as follows:

Water which has absorbed a large amount of ammonia is held in a generator and its temperature raised by steam heated coils. The vaporized water containing ammonia gas rises into the analyzer where it encounters cool liquid, which takes some of the heat from the vapor. The gas then passes into the rectifier where it is cooled by circulating water, which condenses the water vapor but not the ammonia gas. This dry ammonia gas is next conducted to a water cooled condenser where it is liquefied and stored in the receiver. It is then expanded into a brine cooler where it absorbs heat from the brine as it expands into a gas, which in turn goes into the absorber. The gas is taken up by the cold weak liquid and is pumped thru the exchanger into the analyzer thence to the generator.

There are no moving parts in this system to be lubricated, with the exception of the pumps, which do not present unusually difficult lubricating problems unless the exhaust steam from the pumps is condensed and used for ice making purposes. This feature is more fully covered in a later paragraph.

Vacuum System—This system employs water as its refrigerating medium and is a type of the absorption process. The water to be frozen is placed in a vessel connected to a vacuum pump which lowers the pressure above the water to below the vapor pressure. The water begins to boil, taking its heat of vaporization from the water itself and lowering the temperature. The vapor rises to an absorber containing strong sulphuric acid which causes a rapid absorption. The only piece of equipment requiring lubrication is the vacuum pump, and the lubricating service is not severe. For the vacuum cylinder, a light or medium bodied, pale filtered oil should be used, having sufficient viscosity to maintain a seal between the piston rings and the cylinder wall. Texaco Cetus Oil or Texaco Ammonia Oil will give very satisfactory results in these cylinders with minimum consumption.

Compression System—The majority of the refrigerating machines

in commercial use work on this principle and the greater part of them use ammonia as the refrigerating medium. The process briefly is as follows:

The ammonia vapor at a low temperature under a pressure of 5 to 25 pounds enters the compressor thru the suction valves, is compressed to a pressure of 150-180 pounds, and is discharged at this pressure into the line leading to the condenser. In the process of compression the temperature of the gas rises rapidly but as the cylinder is water cooled, the temperature usually does not go above 250° F. After leaving the compressor cylinder, the gas passes thru an oil extractor into the condenser, which consists of a series of coils, pipes or tubes either submerged in water or open to the atmosphere, where part of the heat gained by the gas during compression is absorbed by the cooling water or the air. When properly cooled, the ammonia gas condenses into a liquid and flows to a receiver which acts as a reservoir for the ammonia as well as an oil trap. The ammonia then passes thru an expansion valve, constructed for careful adjustment into the expansion or refrigerating coils. The process of refrigeration takes place during the vaporization of the ammonia from a liquid to a gas, as the expansion of the liquid into vapor absorbs heat from the coils and the surrounding substances until almost complete vaporization has taken place by the time it reaches the suction valves of the compressor cylinder. The expansion coils are, of course, the refrigerating part of the system and the efficiency of the expansion coils determines the degree of satisfaction secured from the installation.

Lubrication of Compressor Cylinders—Considering for the moment only the lubricating requirements of the ammonia compressor cylinder, the characteristics of a suitable oil are such as any high grade air compressor oil would possess. The temperature during compression is comparatively low, probably not over 250° F., and as practically all of the oils that would ever be used have a flash point over 300° F., this feature may be entirely disregarded in the selection of the lubricants.

The mechanical condition of the cylinder wall, piston, piston rings and valves determines the viscosity of the oil that should be used, as the oil must assist the piston rings in maintaining perfect compression. If the cylinder and moving parts are in first class condition, a light bodied oil, such as Texaco Ammonia Oil or Texaco Capella Oil, will give satisfactory results, but if the cylinders are worn out of round thru usage or are scored because of improper lubrication or by the presence of foreign matter, a medium, or heavy bodied oil should be used. An oil of medium body, such as Texaco Cetus Oil, will greatly improve the seal of the piston rings and cylinder and will increase the efficiency of the compressor.

While an oil having the abovementioned characteristics will satisfactorily lubricate the compressor cylinder, there are a number of other operating factors to be considered which frequently make necessary the selection of an oil of other physical characteristics. Regardless of how high the flash point may be, some vaporization will always take place under the high temperatures of compression, and this vapor will be carried out of the cylinder with the ammonia gas. As the compressor cylinder, the condenser, receiver, and expansion coils constitute a closed system, any oil vapor taken out of the compressor

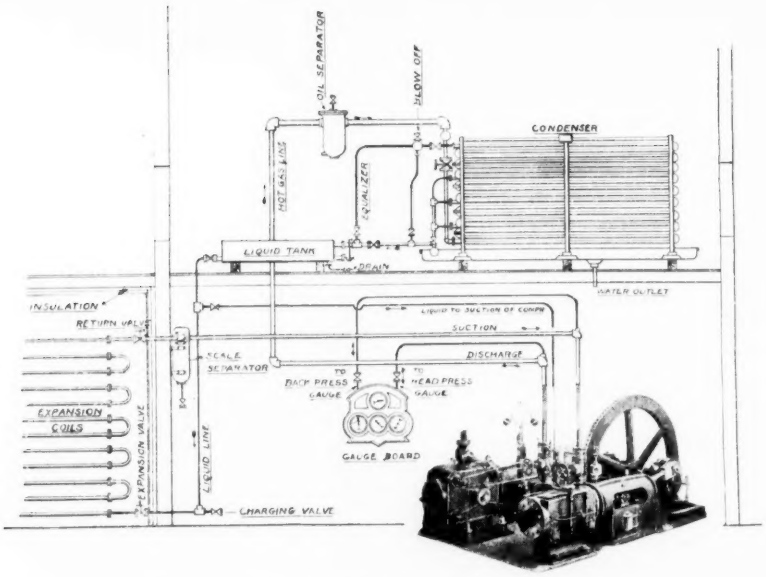


Figure 1—Diagram of Standard Refrigerating Plant.
(De La Vergne Machine Co.)

cylinder necessarily remains in the system and, unless condensed and removed at some point, will gradually cover the internal surfaces of all parts of the system.

All oils, as they become cooler, thicken, until at a certain temperature they cease to flow and congeal into a thick heavy bodied mass. In the event that the oil vapor reaches the condenser and expansion coils it is cooled and liquefied, and unless it has a pour test lower than the temperature in the expansion coils, it will congeal on the inner surfaces of the tubes. This congealed oil in addition to obstructing the passage of ammonia forms a very effective insulator, preventing the transfer of heat to the ammonia and seriously affecting the efficiency and capacity of the refrigeration system. To reduce as far as possible the loss due to the congealing of oil on these surfaces, the lubricant should have a pour test not above zero Fahrenheit, and lower if possible, so that any oil passing the traps and reaching the expansion coils will remain fluid enough to be carried along in the usual cycle of expansion and compression of gases.

Paraffine oils can be made suitable for ammonia compressor lubrication only after careful extraction of the paraffine by refining, a process which lowers the cold test. Texaco Ammonia Oil, Texaco Cetus Oil, Texaco Capella Oil and Texaco Spica Oil, on the other hand, have a natural cold test and remain liquid at 0° F. or below.

To reduce the possibility of oil reaching the coils, all refrigerating machines and their accessories are equipped with oil extractors placed between the compressor and the condenser. These oil trapping devices should be carefully located and constantly watched to see that they are working properly and are drained at regular intervals. Common prac-

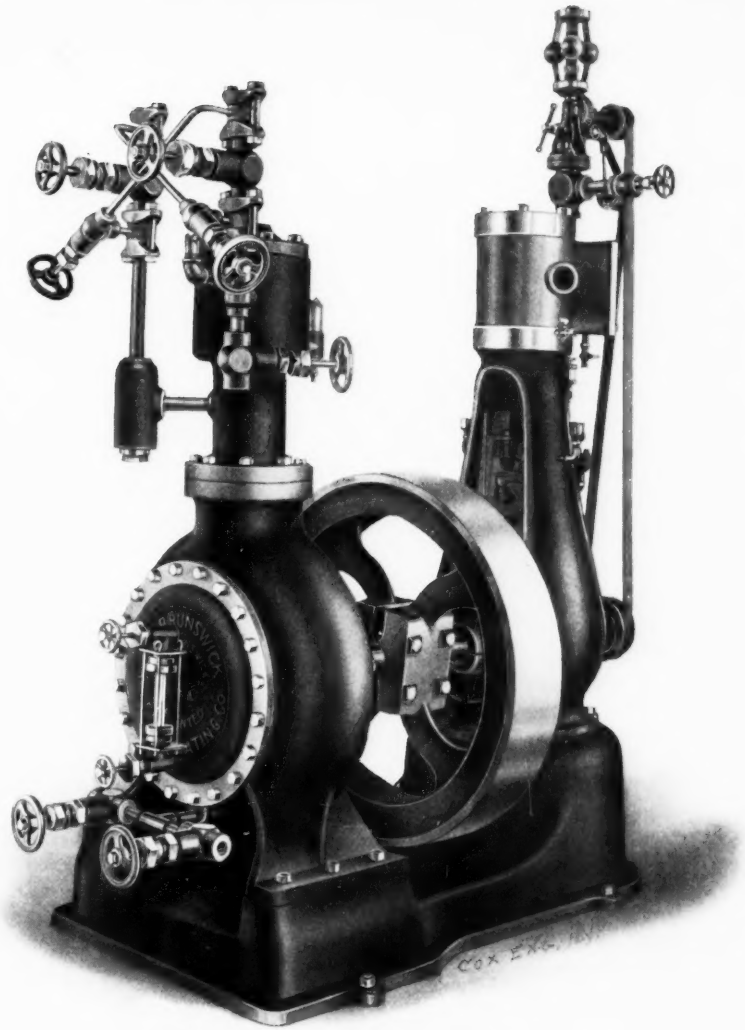


Figure 2—Brunswick Refrigerating Machine.

tice in connection with determining the efficiency of such devices is to check up the amount of oil removed from them with the amount fed to the compressor cylinder. Any great difference is immediately investigated as it would indicate that the oil is not being entirely trapped. In any case the oil supplied to the compressor cylinder should be reduced to a minimum. A surprisingly small amount of oil is required to lubricate the cylinder, and any excess amounts fed are likely to cause trouble.

The location of the oil extractor between the compressor and the condenser, and its efficiency, have a great influence on the viscosity of the oil which may be used in the

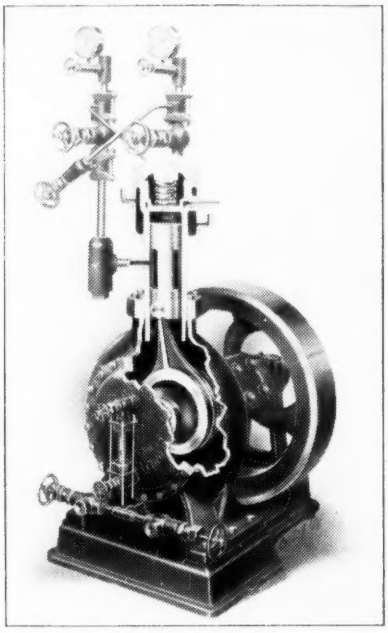


Figure 3
Sectional View of Smaller Brunswick Unit

cylinder. If the oil extractor is located close to the cylinder, a relatively high viscosity oil should be used as the higher viscosity oils have less tendency to vaporize and be carried over with the ammonia gas. On the other hand, if the extractor is placed at some distance from the compressor, a lower viscosity oil may be used, as the oil vapor has a greater length of time in which to condense out of the ammonia gas before it enters the condenser. Consideration of the location of extractors is of vital importance in the selection of the compressor lubricating oil.

Medium bodied paraffine oils which might be suitable in viscosity for the lubrication of worn cylinders or piston rings have a high cold test which renders them unfit for refrigerating work, whereas Texaco Cetus Oil may be very satisfactorily used for these conditions because of its natural zero cold test.

Compressors are made in many types and forms and are lubricated in many ways. The cylinders of machines like the Remington, the Brecht and the Brunswick are lubricated by the splash system, the oil being carried in the crank case at a pre-determined level indicated by a gauge glass and splashed on the parts to be lubricated by the rotating crank. The Brunswick and Remington machines are single acting with one end of the cylinder open so that the splashing of the oil on the inner surface of the cylinder lubricates it in a similar manner to the lubrication of automobile cylinders. The Brunswick machine has two piston rings below the suction inlet which serve to wipe off excessive oil and prevent its being drawn into the cylinder.

There is a possibility with this method of lubrication that, in the event of the operator neglecting the machine and allowing the back pressure to drop below atmospheric pressure in the cylinder, the low pressure in the cylinder may cause a considerable quantity of oil splashed up on the lower part of the cylinder to be drawn in. Such an occurrence, however, is almost always the fault of the operator and with proper attention may be prevented. Oil losses may be reduced by blowing back into the crank case under pressure the oil carried over from the cylinder and deposited in the oil extractor.

Some compressor cylinders are lubricated by circulating oil thru the piston rod stuffing box, which is especially arranged with an oil lantern. A small amount of oil works into the cylinder thru the packing and affords lubrication. The oil in the stuffing box lantern also protects the packing from the

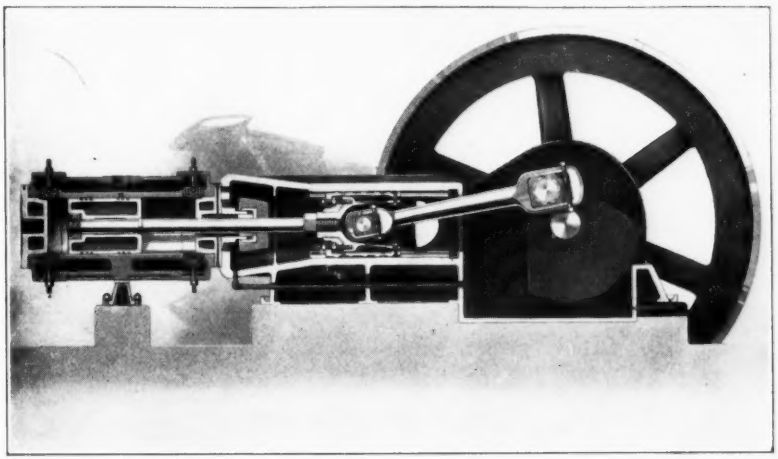


Figure 4—Sectional View of De La Vergne High Speed Ammonia Compressor

action of hot ammonia gas which would have a very bad effect on the packing if it were not for the efficient protection afforded by the oil. The De La Vergne refrigeration machine is lubricated in this manner. Other compressors are equipped with mechanical force feed lubricators or lubricators connected between the intake line and the discharge line, the difference in pressure serving to force the oil thru the regulating valve into the intake line.

In general, under normal service, where pistons and rings are in good condition, the cylinder true, clearance as small as possible, and all valves tight, for machines of fifty tons capacity or over, Texaco Ammonia Oil or Texaco Capella Oil will give perfect satisfaction.

Where oil extractors are located close to the compressor and where cylinders, pistons and rings are worn, a heavier oil such as Texaco Cetus Oil should be used, as this oil will separate more quickly from the ammonia vapor and will maintain better compression in the cylinder.

For the smaller units and for splash lubricated units, a lower viscosity oil such as Texaco Spica Oil will prove very efficient. This lubricant is being used by the United States Navy on Allen Dense Air Machines on practically all battleships and transports, and on ships of the merchant marine equipped with ammonia compression machines.

As a point of interest to operating engineers who may have had trouble with oil passing the oil extractors and congealing in the condenser, experience has shown that this accumulation may be removed by cutting off the water from part of the coils at a time and allowing them to become hot. This thins down the oil and it may then be drained off at the oil trap. If the expansion coils have become coated, the oil may be removed by running the system backwards; that is, by passing the hot ammonia gas back thru the coils, warming them up, and melting down the congealed oil. Sometimes these coils are cleaned by pumping out all of the gas and blowing out the coils with steam and finally with air to remove the moisture. This is dangerous, as some

water may remain in the system and have a bad effect on the ammonia.

Steam Cylinder Lubrication—Unless the exhaust steam is used in making ice, the lubrication of the steam cylinders of steam driven refrigeration machinery and steam pumps presents no unusually difficult lubricating problem. A high grade steam cylinder oil should be selected to meet the operating conditions, bearing in mind the principles involved in the lubrication of ordinary types of steam cylinders. However, if the exhaust steam is condensed and used in making ice, very careful arrangements must be made for the removal of practically all of the oil. For this purpose, oil separators are placed in the exhaust line, and upon their efficiency hinges, to a considerable extent, the selection of a proper oil to be used in the steam cylinders. When the live steam contains moisture, a mineral cylinder oil containing a percentage of fatty oil will give the best results and is, in some instances, absolutely necessary to prevent cutting of the cylinder. On such installations a highly filtered oil, such as Texaco Vanguard Cylinder Oil, should be used as sparingly as possible, and the oil separator should be blown out frequently. Where the steam is reasonably dry, a filtered straight mineral steam cylinder oil may be used if care is taken in the selection of the oil and the method of application. The oil should be introduced into the steam line far enough back from the throttle to insure complete atomization before it reaches the cylinder, as such atomization will permit of the use of minimum quantities of oil.

The discoloration of ice is the most frequent source of complaint from the engineers and operators and in practically all cases is at once blamed on the oil. If the oil is not completely removed from exhaust steam used in making ice, a fan shaped discoloration appears in the block of ice. Rust formed by condensed water left in the cans is often the cause of ice discoloration which can be easily distinguished from oil discoloration as it appears all thru the block and is without definite formation. Texaco Vanguard Mineral Cylinder Oil has given uniformly satisfactory service, and the few complaints registered have been due to lack of proper recognition of essential principles in the operation of the plant.

The Carbon Dioxide machine presents practically the same lubricating conditions as the ammonia machine except that the working pressures are from 900 to 1,000 pounds. The compressor cylinder temperatures are a little higher than those found in ammonia cylinders, but when properly water cooled and arranged with inter-coolers, no lubricating difficulties will be experienced.

The Allen Dense Air Machine however, presents a very interesting lubricating problem because of the extremely low temperatures encountered in this system. Air is compressed to a pressure of from 250 to 300 pounds, the cylinder being water cooled to carry away a part of the heat of compression. The compressed air then goes to a cooler where the temperature is lowered as much as possible by water, and then passed into the air expander, which consists of a cylinder on the same shaft as the compressor cylinder. The air is expanded in this cylinder until the temperature drops to a very low point, sometimes reaching 60° below zero F. The lubrication of the cylinder under such low temperatures is a very difficult problem, as even most of the natural cold test oils congeal

at a few degrees below zero, and to meet these requirements, it is necessary to make an oil from specially selected natural cold test stock. From the expander cylinder the cold air is sent thru the refrigeration coils, where the temperature may be as low as 45° below zero F.

Efficient oil trapping devices should be installed in all cases, and the oil frequently blown out. If this is done no trouble should be experienced from clogging of the expansion coils. Texaco Spica Oil which has a very low cold test is being used by the United States Government for the lubrication of Allen Dense Air Machines on battleships. In all expander installations, as in ammonia compression machines, the oil consumption should be cut down as low as possible and still afford proper cylinder lubrication.

Under some conditions it may be necessary to use a heavier bodied oil for the compression cylinder, in which case great care should be taken to prevent this heavier oil working into the expander cylinder where it may cause trouble.

The lubrication of the external bearings of refrigerating machines is a simple matter, and depends principally upon the methods of applying the oil. If the oil supply is carried in an enclosed crank case and the compressor cylinder is lubricated by splash, the oil used must be suitable for the compressor cylinder and this oil will at the same time lubricate the other bearings. On the other hand, if the compressor cylinder is not lubricated with this oil, an ammonia oil need not be used, but a high grade filtered oil, such as Texaco Regal Oil, which will not emulsify when churned up in the crank case will be satisfactory. This oil also should be used in connection with a water type filter or circulating system attached to the engine, as it separates readily from the water in the filter, returning a clear, clean oil. On bearings lubricated with drip cups or ordinary circulating force feed system, any high grade engine oil of medium viscosity may be used.

While the lubrication of refrigerating machinery has greatly improved in recent years, a closer cooperation between the lubrication engineer, the operating engineer and the builder of the refrigerating machine and its accessories, would undoubtedly insure the continued advancement of improved methods of lubrication.

OIL SEPARATORS FOR EXHAUST STEAM

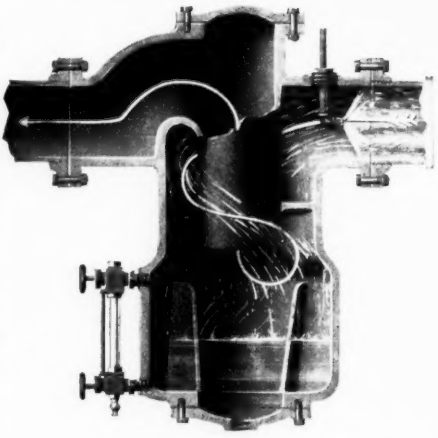
WHILE the raw water system of ice manufacture seems to be increasing, the number of plants still using condensed exhaust steam for making ice is very large. The difficulty experienced in removing the fatty cylinder oils from exhaust steam makes it necessary for the lubrication engineer to recommend the use of a straight mineral cylinder oil for steam cylinder lubrication. There are, however, many installations where the use of a steam cylinder oil containing fatty oil is imperative because of very moist steam.

A mineral steam cylinder oil containing a percentage of fatty oil which will saponify in the presence of moisture in the steam will maintain a more satisfactory lubricating film on the cylinder wall than a straight mineral oil. When such a compounded oil is properly

introduced into the steam lines, that is, far enough back from the cylinder to permit of its thoro atomization, the oil feed can be reduced to a surprisingly low point. If such an oil could always be used in conjunction with efficient separators that will remove the liquid oil, oil vapor and saponified oil from the exhaust steam so completely as to prevent any discoloration or taste in the ice, a great improvement would be made in ice plant lubrication. This is a proposition which needs the careful attention of those operating ice plants, and the proper installation of an efficient separator will be of very considerable benefit. The same improvement in service will be made in power plants using condensed steam for boiler feed purposes. The Griscom-Russell Company have designed an oil separator, a large number of which are now in use. A brief description, furnished by the manufacturer, follows:

"The separation of liquid particles of oil from exhaust steam is a comparatively simple problem if considered by itself. The difficulty is, however, that due to moisture in boiler steam, the cylinder oil manufacturers have to add to the mineral oil a certain per cent. of animal oil to cause it to saponify and spread over the cylinder surfaces. A large percentage of this animal oil is converted into gas at the temperature of the steam in the cylinder, and will not condense into a liquid at the temperature of the exhaust. Naturally the ordinary separator cannot catch this oil gas, as all separators heretofore have been designed to pass all gases with the least obstruction possible, while stopping any liquid, whether oil or water, which was mixed with it.

The oil gas therefore leaves the separator with the steam gas and



Stratton Junior Oil Separator

continues on into the pipes and the feed water heater or the heating system, where it is finally condensed and causes trouble. A real oil separator must therefore provide means of condensing this volatile oil gas into a liquid, as the separator can surely handle liquid.

The Stratton Junior is a combined Gas Washer and Oil Separator. It is simple and efficient. The entering steam must pass thru a curtain of water thrown entirely across the inside of the throat of the Separator by a spray nozzle located in the centre of this inlet steam passage. This spray accomplishes two things:

First—It forms a zone across the pipe in which the temperature is reduced, thereby condensing the oil gas which is in very unstable equilibrium; and as this condensing action occurs in contact with water, the liquid oil, as it forms, collects around the individual particles of spray water just as the skin of a grape surrounds the pulp.

Second—The spray water coming in contact with all particles of liquid oil in the steam collects this oil in the manner already described, the resultant oil covered drops of

water being then carried along with the steam into the Separator and positively thrown out of the steam current by centrifugal action as the steam passes along the spiral passage of the Separator.

On entering the receiver of the Separator, the steam makes a quick turn away from the water and passes out thru a central passage, never again coming in contact with the oily water. The water and oil would continue, if no means were provided to stop the motion, to swirl around the inside of the receiver, but this is avoided by the use of vanes cast in the receiver-walls which arrest this motion.

PRESSURE ABOVE ATMOSPHERE.

Stratton Separators operate by the centrifugal force set up in a current of steam flowing along a spiral passage. All water or oil in the steam, being heavier than the steam itself, will be forced against the wall of the passage and held there as the forward motion of the mass sweeps it down into the receiver-body, where it has no opportunity to again get into the path of the moving steam which passes from the receiver vertically upward thru a central outlet pipe. (Some so-called Centrifugal Separators are so constructed that after the water and oil are once eliminated, the steam again passes thru the water and oil to reach the outlet and will again pick them up and carry them into the piping system.)

Centrifugal action becomes effective at about 200 feet velocity per minute and the action becomes stronger as the velocity increases. In this connection it is worthy of note that baffle-plate Separators, whether containing one or several baffles, cease to be even reasonably effective with steam velocity in excess of 4,500 feet per minute; and even then the builders of this type of Separator recommend oversized steam pipes for several feet ahead of the Separator. With the Stratton Junior Oil Separator you may lay out your exhaust lines for steam velocities varying from 200 feet per minute to 10,000 feet per minute, under normal conditions, and the Separator will always prove efficient and meet any overload conditions that may arise.

Proper methods must be employed to remove the oil and water from the receiver-body of the Separator so as to keep it thoroly drained at all times. We recommend a first class trap for this service.

PRESSURE BELOW ATMOSPHERE.

When steam is exhausted under high vacuum, the oil formed from the lubricating oil in the hot steam cylinder does not liquefy and in consequence the Separator which must remove oil from steam under this condition must first condense this oil gas before it can be eliminated. *The use of a water spray to condense this oil is essential.*

The Stratton Junior Oil Separator does this and then effects the complete elimination of the resultant mixture of oil and water. The design of the apparatus is such that a fine spray is thrown across the entire inside diameter of the pipe by an efficient spray nozzle which may be easily cleaned.

W. S. S.

Are you investing your spare quarters in thrift stamps?

Thrift cards furnish an excellent opportunity to develop habits of thrift and to help win the war.

Redeemable with interest at any time.

On sale everywhere.

LUBRICATION AND CARE OF MOTOR EQUIPMENT

THE phenomenal growth in the use of motor vehicles for commercial purposes has emphasized more strongly than ever the need of proper knowledge and closer attention to the care and maintenance of such equipment in order that it may give the greatest amount of active service and return the largest dividend on the investment.

The commercial vehicle is subjected to the same severe operating conditions as a pleasure car, only much more intensified. As the demand for reliability and serviceability increases, so must greater attention and care be given to its proper maintenance.

The three essential elements in the operation of a motor vehicle are lubricants, water and gasoline. The latter two, water and gasoline, can be properly attended to by periodic inspection.

Lubricants, because of their varied use and wide range of quality and suitability, need closer and more frequent attention. Without lubrication, a car will not run its own length. With lubricants improperly applied or of the wrong grade, it will ruin itself within a very short time.

Motor equipment represents a very valuable investment and when it is considered that it must be protected against wear, break-downs and the rapid deterioration of the entire equipment by the small outlay of fifteen to twenty dollars in the cost of lubricants for one year, it is easily appreciated that the best is none too good and represents the cheapest form of insurance written.

It is not a difficult matter to select the proper lubricants. All oils are not alike. Due to better manufacturing methods and a more complete knowledge of lubrication problems by the refiner, some oils possess higher quality and greater wearing ability than others. This is because this class of oils is especially designed for the purpose for which they are used. High quality is easily proved by the ability of the lubricant to give good service without breaking down from the strain to which it is subjected under operating conditions and by its economy over inferior oils.

To maintain the truck at its highest degree of efficiency, careful attention must be given to the selection of the proper grade of lubricant for each purpose. For the motor, its general mechanical condition will readily determine which grade of lubricating oil will give the most satisfactory results. As these conditions vary more or less with each individual truck, a few moments spent in determining the condition of each unit will be well repaid.

Generally speaking, commercial cars in good mechanical condition and particularly when new, employing any form of splash lubrication should use a medium bodied oil. After the truck has been run until the parts are worn and low compression or lack of power is apparent, better results can be obtained by changing to a heavier grade of oil. Following the same thought commercial cars equipped with any form of force feed lubrication, even when new, should use a heavy oil. These are general recommendations, but will cover the great majority of trucks in use today.

It is a very easy matter for the builder of the motor vehicle to select suitable lubricants by means of shop tests and road tests under actual service conditions. The

manufacturer is then in a position to afford the operator of the motor vehicle a very great service by recommending the lubricants which he has found suitable, insuring himself and his service department against complaints of inefficient operation and defective parts. The protection secured from the recommendations of suitable lubricants is all right as far as it goes, but such recommendations may be made more valuable thru suggestions and instructions for the proper attention and care of the motor vehicle. This point may be illustrated by two or three experiences of our own truck maintenance department.

One of our large tank trucks came into the repair shop one day with a burned out bearing and a badly sprung shaft. An inspection of the motor showed that there was practically no oil at all in the oil chamber beneath the crank case. The driver claimed that the oil gauge showed plenty of oil when he looked at it that morning, so he had not put in the usual amount. On examination it was found that the oil float in the oil chamber which carries an indicator on the top of a long spindle, had stuck tight and did not drop down as the oil was used up, but instead indicated a full supply of oil.

The lack of a little care on the part of the driver in testing out the oil flow, and his failure to check up regularly the performance of the motor with past experiences, resulted in serious damage thru no fault of the oil. A high grade oil which has always been used on this motor could not overcome the lack of a little attention on the part of the driver.

Any oil used in an automobile engine will become more or less contaminated by heavy ends from gasoline, small particles of carbon, moisture, etc. This happened to one of our small tank trucks using a splash circulating system, and the oil lead conveying to the crank case the oil picked up by the fly-wheel, became clogged up and prevented the oil from flowing into the crank case reservoir and maintaining the proper oil level. The results to be expected occurred. This could have been overcome by regularly draining the oil out of the crank case, thoroly washing the crank case out with a mixture of clean oil and kerosene and filling it up with fresh oil at regular intervals. These little experiences may occur in the best of organizations and show very clearly the need for regular inspection and constant attention on the part of those interested in truck maintenance.

In addition to the motor, equally careful attention should be given to the proper lubrication of the other parts. An operator who has once filled the crank case with oil often feels that his lubricating duties are done, but such is not the case. Full protection against wear and break-down can only be accomplished by care and regular attention to the lubrication of all other parts. Those which need attention can be generally classed as follows:

Transmission
Differential
Steering Gear
Spring Suspension
Brake Rods
Clutch Rods
Wheel Bearings
Generator
Starting Motor
Magneto
Distributor
Water Pump
Speedometer
Clutch.

It cannot be expected that once all these parts have been properly

attended to, the car will automatically take care of itself in the future. Frequent inspection and proper renewal of lubricants are absolutely necessary to insure the continued maintenance of reliable service.

If lubrication is given the proper attention it deserves, both by the operator and the manufacturer, the manufacturer will receive fewer complaints and calls for service, the user will secure the maximum returns on his investment and the operating expense on motor vehicles will be completely Hooverized.

The accompanying photograph shows a new Akron-Boston Express Truck, which has just completed its first trip from Akron to Boston. This truck is one of a fleet of seven being operated by the Goodyear Tire & Rubber Company on regular schedule between Akron, Ohio, and Boston, Mass. The route covered includes every character of road, from the level asphalt streets to the 20 per cent. grades in the Allegheny Mountains; Ligonier Mountain being seven and one-half miles in length. The entire distance through the Allegheny Mountains is about one hundred and fifty miles. This new express service represents one of the most important developments of the use of motor trucks to solve the tremendous problem created by the congested conditions of the railroads. Texaco Motor Oil Extra Heavy is used for the lubrication of these trucks.